

SMOKY HILL/SALINE BASIN TOTAL MAXIMUM DAILY LOAD

Waterbody/Assessment Unit: Spillman Creek
Water Quality Impairment: Dissolved Oxygen

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin: Lower Saline

County: Lincoln, Mitchell, Osborne and
Russell

HUC 8: 10260010

HUC 11 (HUC 14s): **020** (040, 050, 060 and 070)

Drainage Area: 174.6 square miles

Main Stem Segment: WQLS: 6 and 8 (Spillman Creek) starting at the confluence with the Saline River in central Lincoln County and traveling upstream to headwaters in southeast Osborne County (**Figure 1**).

Tributaries: Trail Cr (32)
Bacon Cr (7)

Designated Uses: Expected Aquatic Life Support, Secondary Contact Recreation and Food Procurement on Main Stem Segments.

Impaired Use: Expected Aquatic Life Support

Water Quality Standard: Dissolved Oxygen (DO): 5 mg/L (KAR 28-16-28e(c)(2)(A))

2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Support for Designated Use under 2002 303(d): Partially Supporting Aquatic Life

Monitoring Sites: Station 673 near Stockton

Period of Record Used: 1993, 1997 and 2001 for Station 673 (**Figure 2**)

Flow Record: Bow Creek near Stockton flow duration (USGS Station 06876700; 1970-2002) matched to Spillman Creek watershed flow duration at Spillman Creek near Lincoln (USGS Station 06868720)

Long Term Flow Conditions: 10% Exceedance Flows = 54 cfs, 95% = 0.17 cfs

Spillman Creek Watershed Dissolved Oxygen TMDL HUC and Stream Segment Map

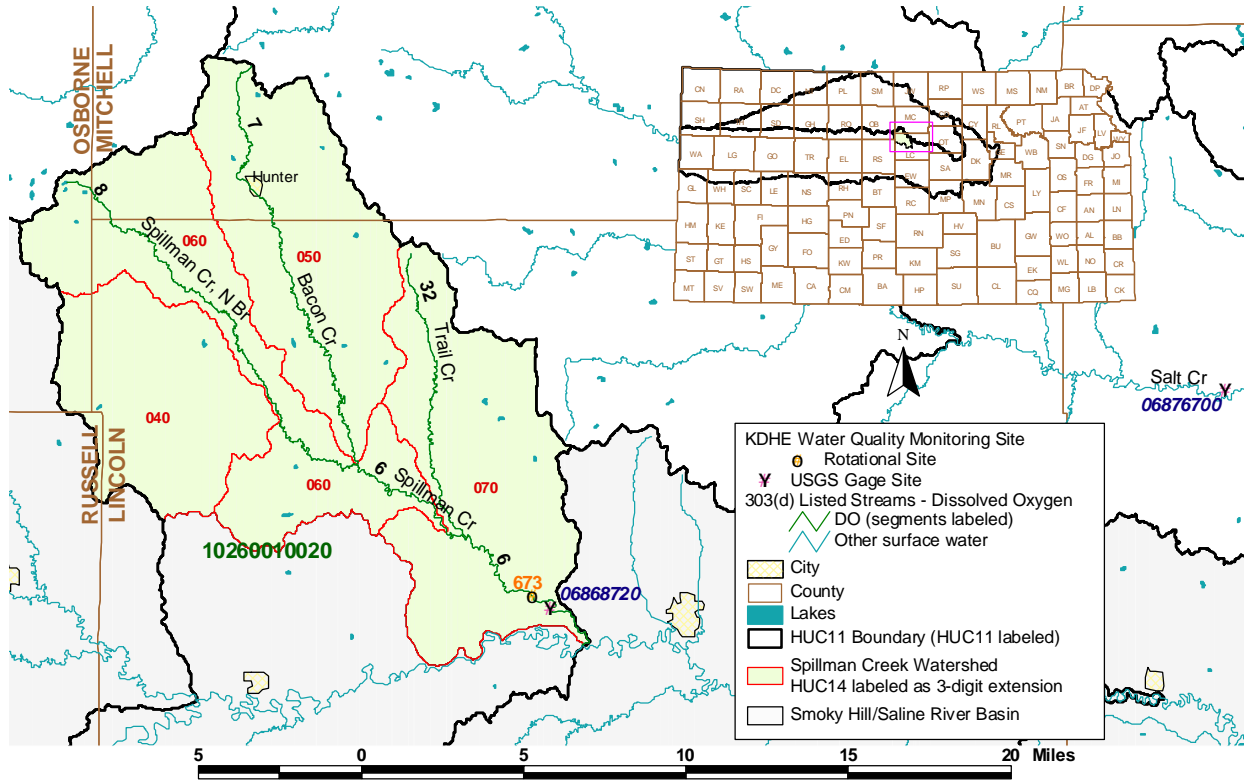


Figure 1

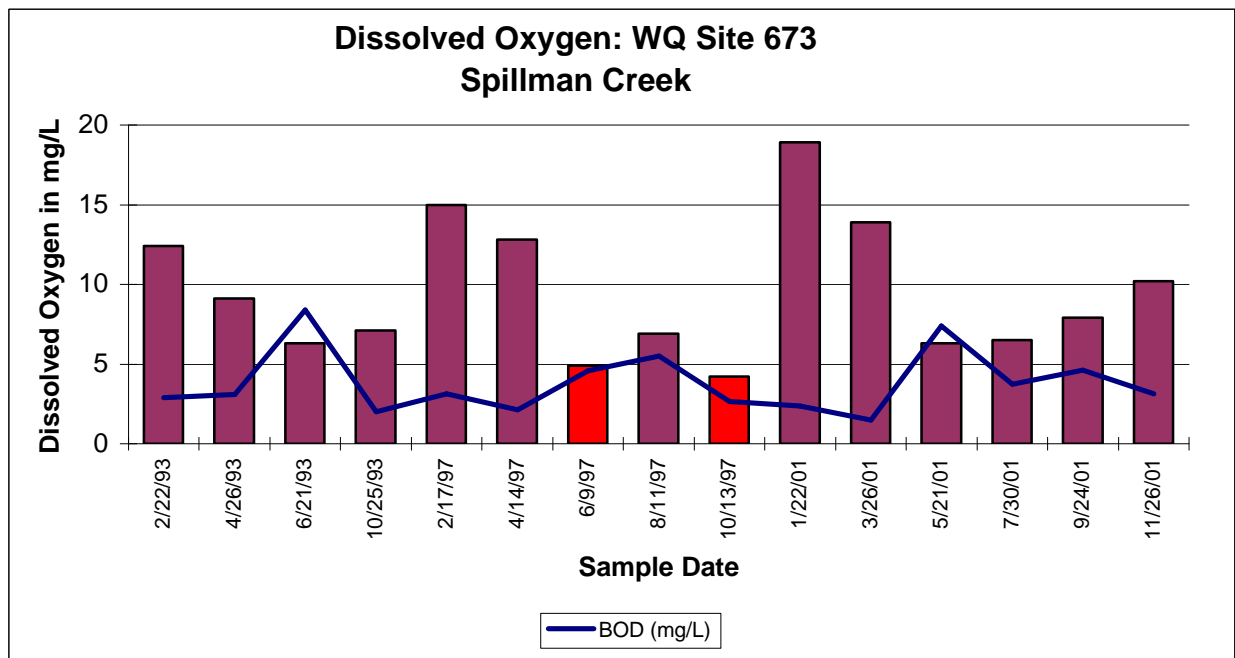


Figure 2

Current Conditions: Since loading capacity varies as a function of the flow present in the stream, this TMDL represents a continuum of desired loads over all flow conditions, rather than fixed at a single value. Sample data for the sampling site were categorized for each of the three defined seasons: Spring (Apr-Jul), Summer-Fall (Aug-Oct) and Winter (Nov-Mar). High flows and runoff equate to lower flow durations; baseflow and point source influences generally occur in the 75-99% range. Load curves were established for the Aquatic Life criterion by multiplying the flow values for Spillman Creek near Lincoln along the curve by the applicable water quality criterion and converting the units to derive a load duration curve of pounds of DO per day. This load curve graphically displays the TMDL since any point along the curve represents water quality at the standard at that flow. Historic excursions from water quality standards (WQS) are seen as plotted points *below* the load curves. Water quality standards are met for those points plotting *above* the applicable load duration curves (**Figure 3**).

Excursions were seen in two of the three define seasons and are outlined in **Table 1**. Seventeen percent of the Spring samples and 25% of Summer-Fall samples were below the aquatic life criterion. None percent of the Winter samples were under the aquatic life criterion. Overall, 13% of the samples were under the criterion. This would represent a baseline condition of partial support of the impaired designated use.

Table 1

NUMBER OF SAMPLES UNDER DISSOLVED OXYGEN STANDARD OF 5mg/L BY FLOW								
Station	Season	0 to 10%	10 to 25%	25 to 50%	50 to 75%	75 to 90%	90 to 100%	Cum. Freq.
Spillman Cr nr Stockton (673)	Spring	0	0	0	1	0	0	1/6 = 17%
	Summer/Fall	0	0	0	0	1	0	1/4 = 25%
	Winter	0	0	0	0	0	0	0/5 = 0%

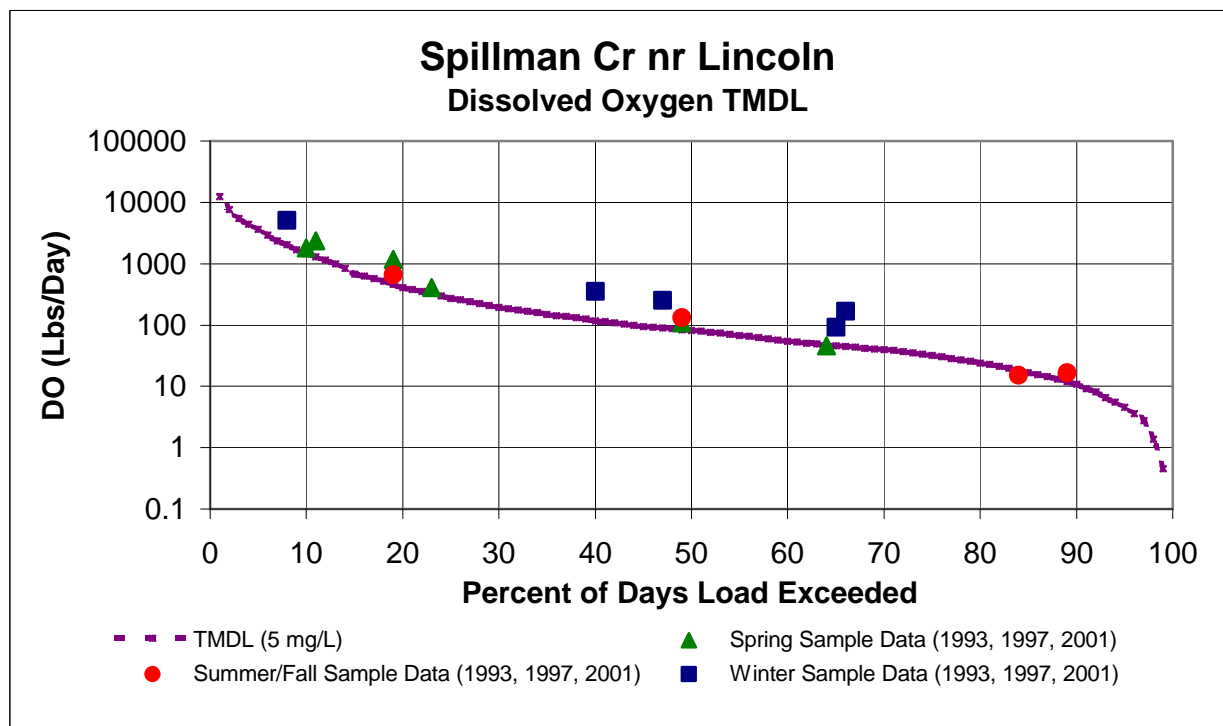


Figure 3

No DO violations have been encountered at flows exceeding 1.75 cfs on Spillman Creek near Lincoln, therefore a critical low flow can be identified on Spillman Creek as those flows of 1.75 cfs or less.

A watershed comparison approach was taken in developing this TMDL. The Bullfoot Creek and Elkhorn Creek watersheds (Water Quality Sampling Sites 672 and 671 in these watersheds are not impaired by low DO) have more grassland as a percent of total area than does the Spillman Creek watershed (**Table 2**), but both are located in close proximity to Spillman Creek just to the south or southeast. The Bullfoot Creek and Elkhorn Creek watersheds are smaller than the Spillman Creek watershed. Neither reference watershed, like Spillman Creek, has any point source dischargers contributing to them that would negatively influence DO levels in their streams.

Table 2

Spillman Cr Watershed (673)			Bullfoot Cr Watershed (672)			Elkhorn Cr Watershed (671)		
Land Use	Acres	% of Total	Land Use	Acres	% of Total	Land Use	Acres	% of Total
Cropland	60,498	54.14	Cropland	18,284	34.47	Cropland	12,176	28.23
Grassland	49,494	44.29	Grassland	34,015	64.12	Grassland	30,087	69.77
Other	0	0.00	Other	104	0.20	Other	136	0.32
Residential	53	0.05	Residential	0	0.00	Residential	0	0.00
Water	433	0.39	Water	179	0.34	Water	105	0.24
Woodland	1,274	1.14	Woodland	465	0.88	Woodland	620	1.44
Total	111,753	100	Total	53,046	100	Total	43,125	100

The relationship of DO to ammonia, biochemical oxygen demand (BOD), fecal coliform bacteria (FCB), water temperature, turbidity, nitrate, phosphorus and pH were used in the comparison.

Table 3 in the Appendix outlines those water quality data for the samples taken on the same date for all three sites. **Table 4 in the Appendix** is the subset of data from Table 3 for those sample dates when DO was below the aquatic life criterion for sample site 673. From Table 4, comparing site 673 to reference sites 672 and 671, the only clear trend that develops is that there was very little or no flow in any of these watersheds when DO problems occurred. In fact, the October 1997 dissolved oxygen excursion (Table 4) at Site 673, was mirrored at reference site 672 and reference site 671 was dry (no sample could even be collected). From this it appears that it is most likely that extremely low flow is the primary factor influencing DO violations in the Spillman Creek watershed.

Desired Endpoints of Water Quality (Implied Load Capacity) at Site 673 over 2008 – 2012

The ultimate endpoint for this TMDL will be to achieve the Kansas Water Quality Standard of 5 mg/l to fully support Aquatic Life.

Seasonal variation is accounted for by this TMDL, since the TMDL endpoint is sensitive to the low flow conditions, usually occurring in the Summer and Fall seasons.

This endpoint will be reached as a result of expected, though unspecified, improvements in tributary buffer strip conditions which will filter sediment before reaching the stream and stream morphology assessments which will be used to determine if enhancement to reaeration of flow within the stream is needed. Improvements to buffer strip conditions will result from

implementation of corrective actions and Best Management Practices, as directed by this TMDL. Achievement of this endpoint will provide full support of the aquatic life function of the creek and attain the dissolved oxygen water quality standard.

Although BOD is most likely not the controlling factor in the occasional DO excursion at this site, to prevent further BOD loading that might offset the benefits of watershed and stream corridor improvements, the BOD target will be to maintain in stream BOD of 3.2 or less at the sampling site. This target was calculated as the median BOD for those data when DO violations did not occur at site 673.

3. SOURCE INVENTORY AND ASSESSMENT

NPDES: There are no NPDES municipal permitted wastewater dischargers within the watershed (**Figure 3**). The city of Hunter (Segment 7 of Bacon Creek) (**Figure 3**) has a non-discharging three cell lagoon system that may contribute an oxygen demanding material load to Spillman Creek under extreme precipitation events (stream flows associated with such events are typically exceeded 1 - 5 % of the time). Such events would not occur at a frequency or of a duration that they would constitute a chronic impairment to the designated uses of the river. They are also unrelated to the critical hydrologic conditions outlined in this TMDL. All non-discharging lagoon systems are prohibited from discharging to the surface waters of the state. Under standard conditions of these non-discharging facility permits, when the water level of the lagoon rises to within two feet of the top of the lagoon dikes, the permit holder must notify KDHE. Steps may be taken to lower the water level of the lagoon and diminish the probability of a bypass of sewage during inclement weather. Bypasses may be allowed if there are no other alternatives and 1) it would be necessary to prevent loss of life, personal injury or severe property damage; 2) excessive stormwater inflow or infiltration would damage the facility; or 3) the permittee has notified KDHE at least seven days before the anticipated bypass. Any bypass is immediately report to KDHE.

Livestock Waste Management Systems: Six operations are registered, certified or permitted within the watershed. These facilities (beef and dairy) are primarily located in the middle or upper end of the watershed (**Figure 3**). Permitted livestock facilities have waste management systems designed to minimize runoff entering their operations or detaining runoff emanating from their areas. Such systems are designed to retain the 25 year, 24 hour rainfall/runoff event, as well as an anticipated two weeks of normal wastewater from their operations. Such rainfall events typically coincides with stream flows that are exceeded less than 1 - 5 percent of the time. Therefore, events of this type, infrequent and of short duration, are not likely to cause chronic impairment of the designated uses of the waters in this watershed especially under the critical low flow condition outlined previously. Requirements for maintaining the water level of the waste lagoons a certain distance below the lagoon berms ensures retention of the runoff from these intense, local storm events. In Lincoln and Mitchell County, such an event would generate 5.4 inches of rain, yielding 4.2 to 5.0 inches of runoff in a day.

NPDES permits, also non-discharging, are issued for facilities with more than 1,000 animal units. None of the facilities in the watershed are of this size. The watershed's total potential

animal units, for all facilities combined, is 1,509. The actual number of animal units on site is variable, but typically less than potential numbers

Spillman Creek Watershed NPDES Sites and Livestock Waste Management Facilities

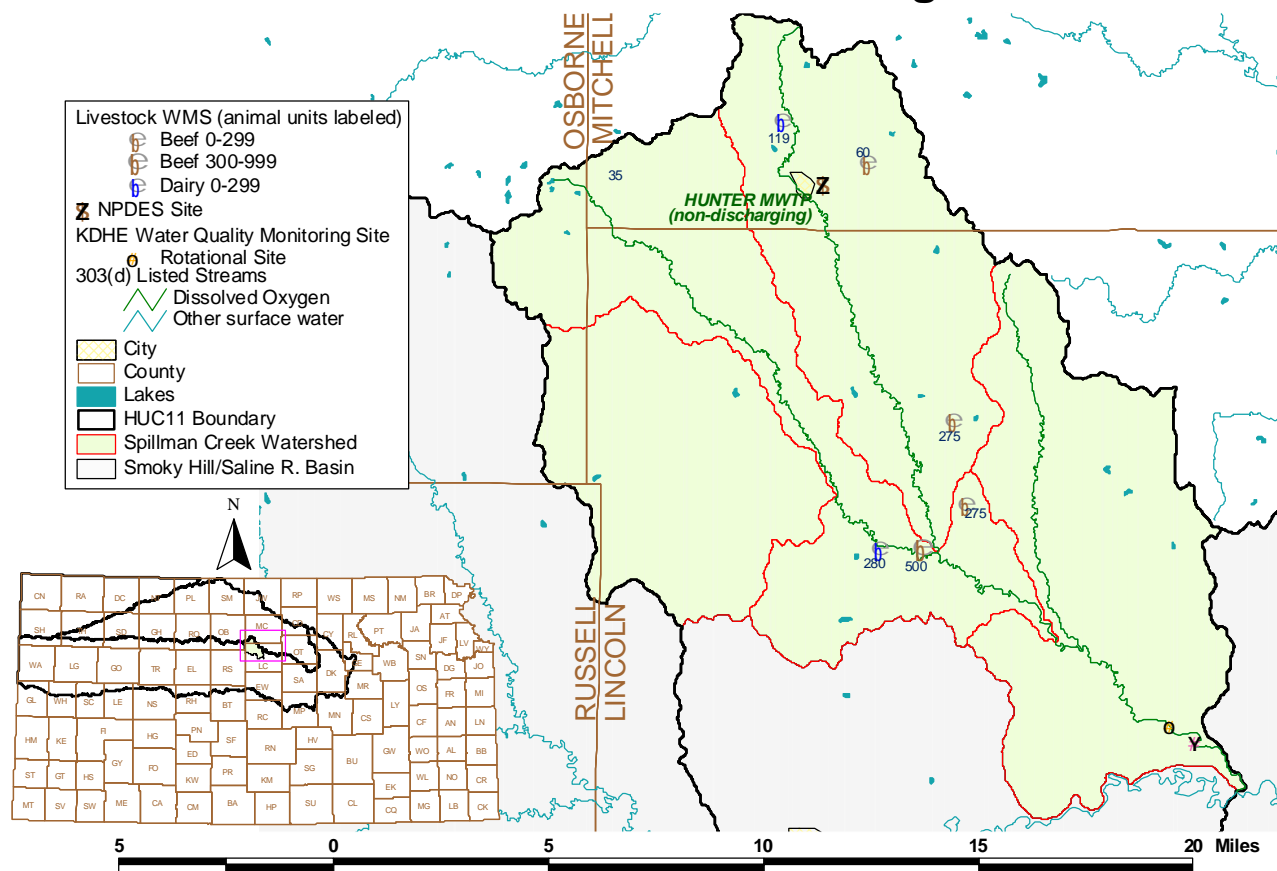


Figure 3

Land Use: Most of the watershed is cropland (54% of the area), grassland (44%), or woodland (1%). Most of the cropland is located along the main stem and tributaries or the perimeter of the watershed. According to the NRCS Riparian Inventory, there are about 13,126 acres of riparian area in the watershed, most of which is categorized as cropland (41%), pasture land (32.5%), forest land (11.4%), crop/tree mix land (8.1%) and pasture/tree mix (5.1%) (**Figure 4**).

On-Site Waste Systems: The watershed's population density is low (2 persons/sq mi) when compared to densities elsewhere in the Smoky Hill/Saline Basin (**Figure 4**). The rural population projections for Lincoln and Osborne Counties through 2020 show declines of about 19% for each county while the rural population project for Mitchell County also indicates a decline, but of only 5%. Based on 1990 census data, about 40% of households in Lincoln County, 22% of households in Mitchell County and 27% of households in Osborne County are on septic systems. While failing on-site waste systems can contribute oxygen demanding substance loadings, their impact on the impaired segments is generally limited, given the small size of the rural population and magnitude of other sources in the watershed.

Contributing Runoff: The Spillman Creek watershed's average soil permeability is 0.9 inches/hour according to NRCS STATSGO database. The entire watershed produces runoff even under relatively low (1.71"/hr) potential runoff conditions (100%). Under very low (1.14"/hr) potential conditions, this potential contributing area is reduced to about 66%. Runoff is chiefly generated as infiltration excess with rainfall intensities greater than soil permeabilities. As the watersheds' soil profiles become saturated, excess overland flow is produced. Generally, storms producing less than 0.57"/hr of rain will only generate runoff from 10% of this watershed, chiefly from the very upper and lower ends of the watershed.

Spillman Creek Watershed Riparian Inventory, Land Use and Population Density

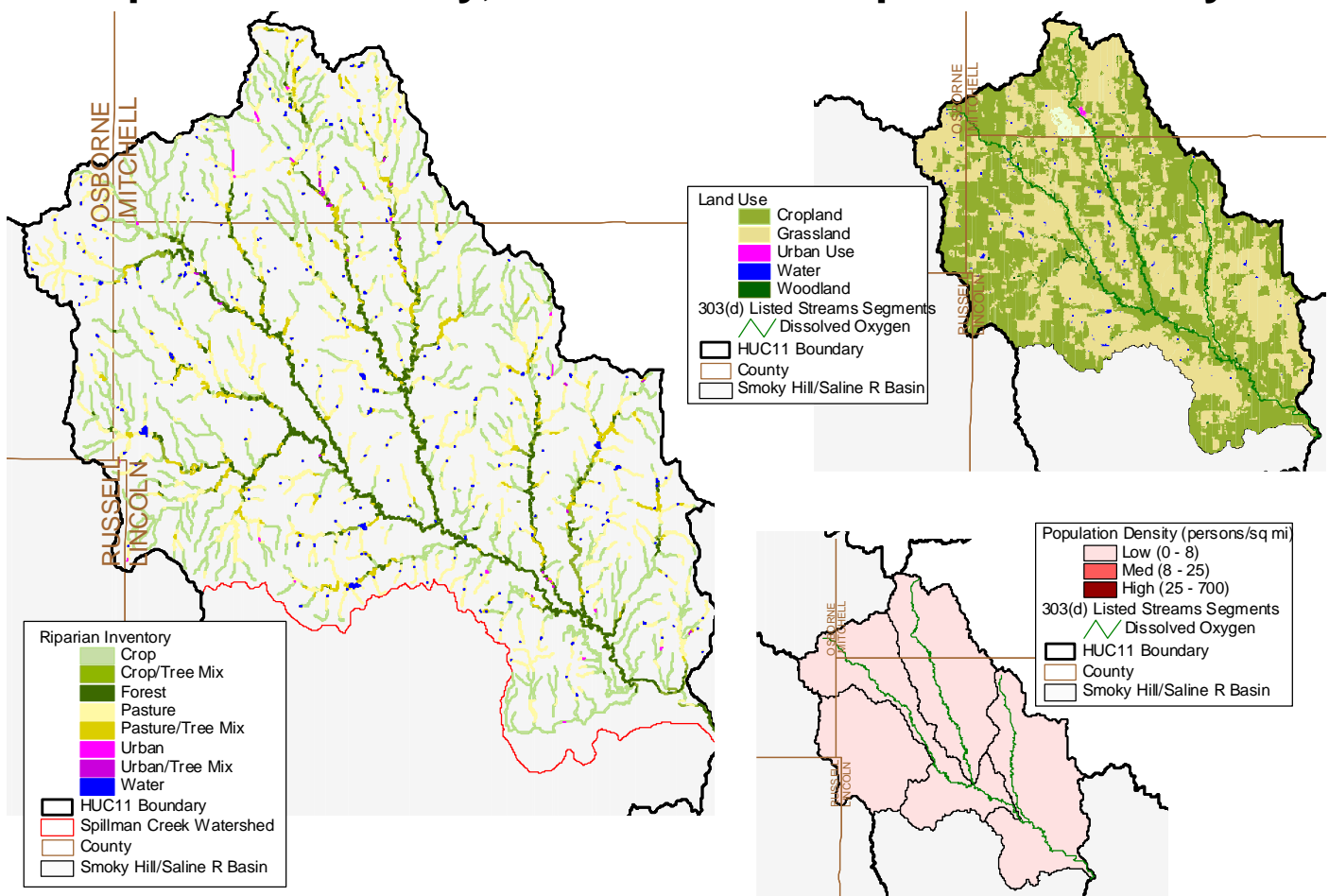


Figure 4

Background Levels: Some organic enrichment may be associated with environmental background levels, including contributions from wildlife and stream side vegetation, but it is likely that the density of animals such as deer is fairly dispersed across the watershed and that the loading of oxygen demanding material is constant along the stream. In the case of wildlife, this loading should result in minimal loading to the streams below the levels necessary to violate

the water quality standards. In the case of stream side vegetation, the loading should be greatest along the main stem of the watershed with its larger proportion of woodland near the stream.

4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY

BOD is a measure of the amount of oxygen required to stabilize organic matter in a stream. As such, BOD is used as a benchmark measure to anticipate DO levels while it measures the total concentration of DO that will be demanded as organic matter degrades in a stream. It is presumed that the maintenance of historical BOD loads with improvements to tributary buffers and any stream restoration projects cited by local assessments will reduce DO excursions under certain critical flow conditions. Therefore, any allocation of wasteloads and loads will be made in terms of BOD.

This is a phased TMDL. Additional monitoring over time will be needed to further ascertain the relationship between enhancements in stream restoration and tributary buffer strip conditions, which should filter sediment before reaching the stream, reduce sediment oxygen demand and consequently improve DO levels during the critical flow periods of concern. In Phase One of this TMDL the following allocations apply:

Point Sources: A current Wasteload Allocation of zero is established by this TMDL because of the lack of discharging point sources located upstream of monitoring site 673. Should future point sources be proposed in the watershed and discharge into the impaired segments, the current Wasteload Allocation will be revised by adjusting current load allocations to account for the presence and impact of these new point source dischargers (**Figure 6**).

There will be a wasteload allocation of zero for state permitted CAFO's within the drainage because of requirements for no discharge of livestock waste except at 25 year, 24 hour storm events. Management of available freeboard and required holding capacities in these livestock waste management systems should ensure rare contribution of organic matter to Spillman Creek, causing depletion of oxygen in the stream.

Non-Point Sources: Again, because of the indications that low flow is the driving factor causing the occasional excursion from the water quality standard rather than BOD, non-point sources are not seen as a significant source of DO excursion in the watershed. The Load Allocation assigns responsibility for maintaining the historical median in-stream BOD levels at site 673 to 3.2 mg/L across all flow conditions (**Figure 6**).

To address any artificial sources factoring into the DO violations outlined in **Table 4 of the Appendix** at water quality sampling site 673, buffer strips should be installed on directly contributing tributaries to filter sediment before reaching the stream.

Defined Margin of Safety: The Margin of Safety will be implied based on conservative assumptions used to set the target BOD concentration, since sampling data indicates exceeding this value has seldom led to a dissolved oxygen violation.

State Water Plan Implementation Priority: Because this watershed has indicated some problem with dissolved oxygen which has short term and immediate consequences for aquatic

life and the watershed has multiple impairments (the watershed is also impaired by fecal coliform bacteria), this TMDL will be a High Priority for implementation.

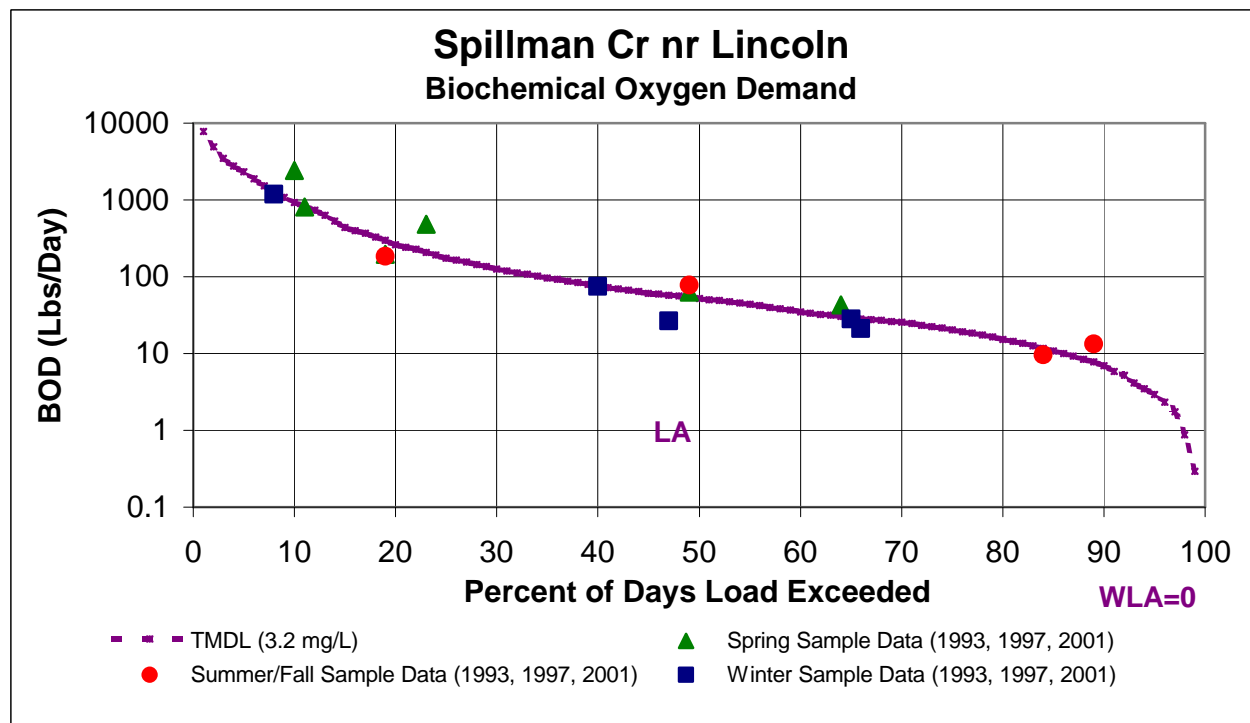


Figure 5

Unified Watershed Assessment Priority Ranking: This watershed lies within the Lower Saline Basin (HUC 8: 10260010) with a priority ranking of 33 (Medium Priority for restoration work).

Priority HUC 11s and Stream Segments: Priority focus of implementation prior to 2008 will concentrate on installing best management practices adjacent to main stem segments and flow contributing tributaries.

5. IMPLEMENTATION

Desired Implementation Activities

1. Conduct stream morphology review
2. Where needed, create/restore buffer strips along contributing tributaries.

Implementation Programs Guidance

Stream Restoration Program - SCC

- a. Conduct a stream morphology evaluation along the stream reaches in the vicinity of the monitoring station.

- b. Assess the degree to which sediment is altering stream flow patterns in the channel, including reducing slopes and aeration capability along the stream bed.
- c. Ascertain probable sources of sediment deposition in stream, should it be a primary factor in influencing stream aeration or exerting oxygen demand.
- d. Plan, design and install stream restoration measures which will restore stream flow conveyance and sediment transport capability to the target stream reaches.

Buffer Initiative Program - SCC

- a. Install grass buffer strips near streams.

Timeframe for Implementation: Stream morphology assessments/restoration measures and buffer strips should be installed on main stream and directly contributing tributaries over the years 2004-2008.

Targeted Participants: Primary participants for implementation will be landowners immediately adjacent to the listed stream segments. Implemented activities should be targeted to those stream segments with greatest potential contribution to baseflow. Nominally, this would be most likely be :

1. Unbuffered cropland adjacent to contributing tributaries.
2. Unstable stream banks and modified channels.

Some inventory of local needs should be conducted in 2004 to identify such activities. Such an inventory would be done by local program managers with appropriate assistance by commodity representatives and state program staff in order to direct state assistance programs to the principal activities influencing the quality of the streams in the watershed during the implementation period of this TMDL.

Milestone for 2008: The year 2008 marks the mid-point of the ten-year implementation window for the watershed. At that point in time, milestones should be reached which will have at least two-thirds of the landowners responsible for buffer strip restoration or stream restoration measures, cited in the local assessment, participating in the implementation programs provided by the state.

Delivery Agents: The primary delivery agents for program participation will be the conservation districts for programs of the State Conservation Commission and the Natural Resources Conservation Service. Producer outreach and awareness will be delivered by Kansas State County staff managing.

Reasonable Assurances:

Authorities: The following authorities may be used to direct activities in the watershed to reduce pollution.

1. K.S.A. 65-164 and 165 empowers the Secretary of KDHE to regulate the discharge of sewage into the waters of the state.

2. K.S.A. 65-171d empowers the Secretary of KDHE to prevent water pollution and to protect the beneficial uses of the waters of the state through required treatment of sewage and established water quality standards and to require permits by persons having a potential to discharge pollutants into the waters of the state.
3. K.A.R. 28-16-69 to -71 implements water quality protection by KDHE through the establishment and administration of critical water quality management areas on a watershed basis.
4. K.S.A. 2-1915 empowers the State Conservation Commission to develop programs to assist the protection, conservation and management of soil and water resources in the state, including riparian areas.
5. K.S.A. 75-5657 empowers the State Conservation Commission to provide financial assistance for local project work plans developed to control non-point source pollution.
6. K.S.A. 82a-901, *et seq.* empowers the Kansas Water Office to develop a state water plan directing the protection and maintenance of surface water quality for the waters of the state.
7. K.S.A. 82a-951 creates the State Water Plan Fund to finance the implementation of the *Kansas Water Plan*.
8. The *Kansas Water Plan* and the Smoky Hill/Saline Basin Plan provide the guidance to state agencies to coordinate programs intent on protecting water quality and to target those programs to geographic areas of the state for high priority in implementation.

Funding: The State Water Plan Fund, annually generates \$16-18 million and is the primary funding mechanism for implementing water quality protection and pollution reduction activities in the state through the *Kansas Water Plan*. The state water planning process, overseen by the Kansas Water Office, coordinates and directs programs and funding toward watersheds and water resources of highest priority. Typically, the state allocates at least 50% of the fund to programs supporting water quality protection. This watershed and its TMDL are a High Priority consideration.

Effectiveness: Buffer strips are touted as a means to filter sediment before it reaches a stream and riparian restoration projects have been acclaimed as a significant means of stream bank stabilization. The key to effectiveness is participation within a finite subwatershed to direct resources to the activities influencing water quality. The milestones established under this TMDL are intended to gauge the level of participation in those programs implementing this TMDL.

Should participation significantly lag below expectations over the next five years or monitoring indicates lack of progress in improving water quality conditions from those seen over 1993, 1997 and 2001 the state may employ more stringent conditions on agricultural producers and urban runoff in the watershed in order to meet the desired endpoints expressed in this TMDL. The state has the authority to impose conditions on activities with a significant potential to pollute the

waters of the state under K.S.A. 65-171. If overall water quality conditions in the watershed deteriorate, a Critical Water Quality Management Area may be proposed for the watershed, in response.

6. MONITORING

KDHE will continue to collect bimonthly samples at rotational Station 673 in 2005 including dissolved oxygen samples, in order to assess progress and success in implementing this TMDL toward reaching its endpoint. Should impaired status remain, the desired endpoints under this TMDL will be refined and more intensive sampling may need to be conducted under specified lower flow conditions over the period 2008-2012. Use of the real time flow data available at the Bow Creek near Stockton stream gaging station can help direct these sampling efforts.

A stream restoration review will be conducted in 2005 by the State Conservation Commission to evaluate Spillman Creek in terms of morphology and sediment impacts on stream flow patterns and its effect on aeration within the stream as outlined in the implementation guidance.

Local program management needs to identify its targeted participants of state assistance programs for implementing this TMDL. This information should be collected in 2004 in order to support appropriate implementation projects.

7. FEEDBACK

Public Meetings: Public meetings to discuss TMDLs in the Smoky Hill/Saline Basin were held October 3, 2002, January 7, 2003 and March 5, 2003 in Hays. An active Internet Web site was established at <http://www.kdhe.state.ks.us/tmdl/> to convey information to the public on the general establishment of TMDLs and specific TMDLs for the Smoky Hill/Saline Basin.

Public Hearing: Public Hearings on the TMDLs of the Smoky Hill/Saline Basin were held in Hays on June 4, 2003.

Basin Advisory Committee: The Smoky Hill/Saline Basin Advisory Committee met to discuss the TMDLs in the basin on October 3, 2002, January 7, March 5, and June 2, 2003.

Milestone Evaluation: In 2008, evaluation will be made as to the degree of implementation that has occurred within the watershed and current condition of Spillman Creek. Subsequent decisions will be made regarding the implementation approach and follow up of additional implementation in the watershed.

Consideration for 303(d) Delisting: The stream will be evaluated for delisting under Section 303(d), based on the monitoring data over the period 2008-2012. Therefore, the decision for delisting will come about in the preparation of the 2012 303(d) list. Should modifications be made to the applicable water quality criteria during the ten-year implementation period, consideration for delisting, desired endpoints of this TMDL and implementation activities may be adjusted accordingly.

Incorporation into Continuing Planning Process, Water Quality Management Plan and the Kansas Water Planning Process: Under the current version of the Continuing Planning Process, the next anticipated revision will come in 2003 which will emphasize implementation of TMDLs. At that time, incorporation of this TMDL will be made into both documents. Recommendations of this TMDL will be considered in *Kansas Water Plan* implementation decisions under the State Water Planning Process for Fiscal Years 2004-2008.

Appendix to Spillman Creek Dissolved Oxygen TMDL

Table 3

Date	DO			Ammonia			BOD			FCB			Nitrate			pH			Temp_Cent			Phos			Turb			Flow
	673	672	671	673	672	671	673	672	671	673	672	671	673	672	671	673	672	671	673	672	671	673	672	671	673	672	671	673
2/22/93	12.4	13	12.8	0.1	0.05	0.05	2.9	1.4	1.6	70	12	114	2.51	0.99	1	9.8	8.1	8	0	0	0	0.18	0.07	0.05	20.0	16.5	11.3	75.60
4/26/93	9.1	9.7	9	0.05	0.05	0.05	3.1	2.2	2.6	84	72	90	1.39	0.98	0.8	7.9	8	7.9	12	12	11	0.09	0.05	0.39	15.0	6.9	26.0	48.05
6/21/93	6.3	7	7.2	0.05	0.05	0.05	8.4	3.4	3	15800	800	1300	2.07	1.86	1.21	7.9	8.1	8	19	19	19	0.53	0.14	0.13	200.0	12.0	23.0	53.76
8/23/93	ND	7.5	6.7	ND	0.05	0.05	ND	ND	1.2	ND	500	600	ND	2.99	2.78	ND	8.1	7.9	ND	20	20	ND	0.2	0.1	ND	23	16	-----
10/25/93	7.1	8.7	8.3	0.05	0.06	0.05	2	2.3	1.5	200	10	220	3.76	2.77	2.24	7.6	7.8	7.6	10	9	10	0.23	0.1	0.1	13.0	2	13	17.14
2/17/97	15	12.2	13.5	0.02	0.02	0.02	3.15	1.74	1.51	10	10	25	1.63	0.98	0.79	7.8	7.8	7.8	4	5	2	0.09	0	0.04	3.0	1	10.5	4.37
4/14/97	12.8	12.2	12	0.02	0.02	0.02	2.13	3.24	2.01	10	80	250	1.28	0.68	0.46	7.9	7.8	7.9	7	16	16	0.12	0.05	0.05	5.0	10.1	9.9	17.14
6/9/97	4.9	5	6.3	0.212	0.173	0.349	4.56	3.9	3.06	150	120	500	1.39	0.64	0.48	7.7	7.8	7.8	19	19	18	0.43	0.20	0.14	28.0	32.0	20.0	1.75
8/11/97	6.9	6.1	8.2	0.02	0.037	0.035	5.52	5.31	10.8	500	800	17000	0.2	0.17	0.12	7.9	7.9	7.8	20	20	19	0.53	0.40	0.30	60.0	100.0	52.0	0.45
10/13/97	4.2	3.8	dry	0.02	0.02	dry	2.64	3.12	dry	20	60	dry	0.13	0.22	dry	7.9	7.8	dry	13	13	dry	0.37	0.31	dry	31.0	48.0	dry	0.68
1/22/01	17.8	14.3	15.3	0.25	0.02	0.02	5.6	1.35	2.07	10	10	10	0.99	1.06	1.43	7.7	7.8	8	1	0	0	0.26	0.03	0.03	8.1	2.1	1.8	1.64
3/26/01	13.9	14.2	13.6	0.02	0.02	0.02	1.47	1.47	1.72	120	20	35	0.9	0.99	1.01	7.7	7.9	8.1	7	6	5	0.14	0.11	0.08	2.7	6.8	6.1	3.33
5/21/01	6.3	8.6	9.3	0.155	0.148	0.121	7.38	5.07	2.82	7000	7000	1600	0.59	0.61	1.13	7.4	7.8	7.9	16	17	16	0.76	0.47	0.15	190.0	150.0	33.0	12.10
7/30/01	6.5	6.3	4.7	0.07	0.089	0.032	3.75	2.37	2.19	8000	500	710	1.99	0.97	0.99	7.5	7.7	7.4	27	27	27	0.94	0.24	0.33	390.0	44.0	36.0	3.12
9/24/01	7.9	8.3	8.4	0.044	0.033	0.02	4.62	2.52	2.97	1200	520	1400	0.82	1.25	1.55	7.6	7.8	7.9	16	16	16	0.57	0.18	0.15	240.0	16.0	19.0	3.12
11/26/01	10.2	9.5	9.2	0.02	0.038	0.02	3.12	2.64	2.76	460	2500	220	0.34	1.33	0.83	7.8	7.8	7.6	9	9	10	0.19	0.11	0.04	8.3	4.0	2.3	1.68
Median	9.4	9.2	9.6	0.07	0.05	0.06	4.02	2.80	2.79	2242	813	1605	1.33	1.16	1.12	7.9	7.9	7.8	12	13	13	0.36	0.16	0.14	80.9	29.7	18.7	16.3

Table 4

Date	DO			Ammonia			BOD			FCB			Nitrate			pH			Temp_Cent			Phos			Turb			Flow
	673	672	671	673	672	671	673	672	671	673	672	671	673	672	671	673	672	671	673	672	671	673	672	671	673	672	671	673
6/9/97	4.9	5	6.3	0.212	0.173	0.349	4.56	3.9	3.06	150	120	500	1.39	0.64	0.48	7.7	7.8	7.8	19	19	18	0.43	0.20	0.14	28.0	32.0	20.0	1.75
10/13/97	4.2	3.8	dry	0.02	0.02	dry	2.64	3.12	dry	20	60	dry	0.13	0.22	dry	7.9	7.8	dry	13	13	dry	0.37	0.31	dry	31.0	48.0	dry	0.68
Median	4.6	4.4	-----	0.12	0.1	-----	3.60	3.5	-----	85	90.0	-----	0.76	0.4	-----	7.8	7.8	-----	16	16	-----	0.40	0.3	-----	29.5	40.0	-----	1.2